EFFECT OF CONFINED ELECTROLYTE VOLUMES ON GALVANIC CORROSION KINETICS IN STATICALLY LOADED MATERIALS

Steve Policastro, Center for Corrosion Science and Engineering, U.S. Naval Research Laboratory
steven.policastro@nrl.navy.mil
Carlos Hangarter, Center for Corrosion Science and Engineering, U.S. Naval Research Laboratory
Rachel Anderson, NRC Post-doctoral Fellow at the U.S. Naval Research Laboratory
Fritz Friedersdorf, Luna Innovations, Inc.

Key Words: Galvanic corrosion, atmospheric corrosion, aluminum, stainless steels

This work investigates the effects that the confined volume of atmospheric electrolytes has on the galvanic corrosion kinetics of martensitic stainless steel alloys coupled with UNS A97075 in simulated atmospheric environments at relative humidity values that span the range of operational exposures. Restricted volumes found in thin films and droplets have been shown to control reduction reaction kinetics and are an ongoing challenge to characterize and standardize . This, along with the dynamic and high concentration of aggressive ions found in confined electrolytes, creates a unique corrosion system that requires a multifaceted approach to evaluate varied conditions, compare them with traditional measurements and more accurately predict galvanic atmospheric corrosion. In this work, corrosion currents in galvanic couples were obtained under three environmental conditions:

1. Bulk electrolytes, in a standardized test configuration, with chemistries relevant to atmospheric electrolytes
2. Thin electrolyte films formed using the Luna test cell and equilibrated at a given temperature and relative humidity
3. Deliquesced droplets formed and equilibrated at multiple temperature and relative humidity values.

In addition, the corrosion currents for the same galvanic couple specimens were evaluated, using an NRL-developed experimental approach, under droplet electrolytes while statically loaded, as shown in Figure 1. These corrosion currents were then compared to the currents obtained from the unloaded conditions.

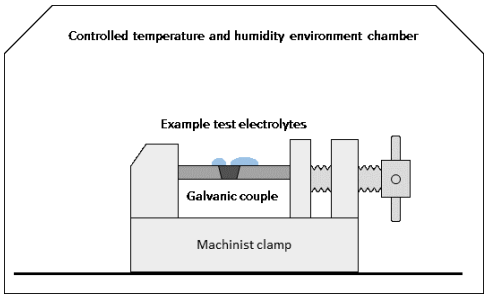

Figure 1 Test set-up for measuring galvanic corrosion currents on statically loaded galvanic couples.